

## WHAT IS CLAIMED IS:

1. A control system for an internal combustion engine, comprising:  
an intake valve;  
a variable valve mechanism capable of changing a degree of an operating angle  
5 and a phase of a valve-open period of the intake valve;  
a knock sensor for detecting a knocking in the internal combustion engine, and  
a controller that selectively executes at least one of a plurality of knock  
controls including a phase adjustment of the valve-open period of the intake valve  
when a knocking is detected by the knock sensor,  
10 wherein the controller is adapted to perform a knock control mode in which a  
knock control is selected and executed such that a valve-open timing of the intake  
valve does not exceed a predetermined timing that is retarded from a top dead center  
by a predetermined angle when the operating angle of the intake valve is smaller than  
180 degrees.  
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2. The control system according to claim 1, wherein the controller is adapted to,  
during the knock control mode, advance the valve-open timing of the intake valve if  
the valve-open timing of the intake valve is after the top dead center when a knocking  
occurs.  
20
3. The control system according to claim 2, wherein the controller is adapted to  
advance the valve-open timing of the intake valve by advancing the phase of the  
valve-open period while maintaining the operating angle of the intake valve.
- 25 4. The control system according to claim 2, wherein the controller is adapted  
to advance the valve-open timing of the intake valve by increasing the operating angle  
of the intake valve.
- 30 5. The control system according to claim 1, wherein the controller is adapted to,  
during the knock control mode, select a knock control such that the valve-open timing  
of the intake valve does not exceed the predetermined timing that is retarded from the  
top dead center by the predetermined angle, and a valve-close timing of the intake  
valve does not enter a predetermined range near a bottom dead center.

6. The control system according to claim 1, wherein the controller is adapted to correct an ignition timing based on the valve-open timing and the valve-close timing of the intake valve when no knocking occurs.

5           7. The control system according to claim 6, wherein the controller is adapted to retard the ignition timing as the valve-open timing of the intake valve is retarded from the top dead center, and the valve-close timing of the intake valve approaches the bottom dead center.

10           8. A control system for an internal combustion engine, comprising:  
an intake valve;  
a variable valve mechanism capable of changing an operating angle of the  
intake valve and a phase of a valve-open period of the intake valve;  
a knock sensor for detecting a knocking in the internal combustion engine; and  
15           a controller that selectively executes at least one of a plurality of knock  
controls including a phase adjustment of the valve-open period of the intake valve  
when a knocking is detected by the knock sensor,  
wherein the controller is adapted to, when a knocking is detected by the knock  
sensor, determine the present setting condition of a valve-open timing and valve-close  
20           timing of the intake valve among four setting conditions: i) a first setting condition in  
which the valve-open timing of the intake valve is before a top dead center and the  
valve-close timing is before a bottom dead center; ii) a second setting condition in  
which the valve-open timing of the intake valve is after the top dead center and the  
valve-close timing is before the bottom dead center; iii) a third setting condition in  
25           which the valve-open timing of the intake valve is before the top dead center and the  
valve-close timing is after the bottom dead center; and iv) a fourth setting condition in  
which the valve-open timing of the intake valve is after the top dead center and the  
valve-close timing is after the bottom dead center, and execute a knock control that is  
selected beforehand for each of the four setting conditions.

30           9. The control system according to claim 8, wherein the controller is adapted to advance the valve-open timing of the intake valve if the intake valve is in the second setting condition when a knocking is detected by the knock sensor.

10. A control method for an internal combustion engine with a variable valve mechanism capable of changing an operating angle of an intake valve and a phase of a valve-open period of the intake valve, the control method being characterized by comprising:

- 5           a detection step of detecting a knocking in the internal combustion engine; and
- a selection-execution step of selectively executing at least one of a plurality of knock controls including a phase adjustment of the valve-open period of the intake valve when a knocking is detected,
- wherein in the selection-execution step a knock control is selected and
- 10       executed such that a valve-open timing of the intake valve does not exceed a predetermined timing that is retarded from a top dead center by a predetermined angle, when the operating angle of the intake valve is smaller than 180 degrees.

11. A control method of controlling an internal combustion engine with a variable valve mechanism capable of changing an operating angle of an intake valve and a phase of a valve-open period of the intake valve, the control method being characterized by comprising:

- a detection step of detecting a knocking in the internal combustion engine, and
- a selection-execution step of selectively executing at least one of a plurality of
- 20       knock controls including a phase adjustment of the valve-open period of the intake valve when a knocking is detected,
- wherein the selection-execution step includes determining, when a knocking is detected, the present setting condition of the valve-open timing and the valve-close timing of the intake valve among four setting conditions: i) a first setting condition in
- 25       which a valve-open timing of the intake valve is before a top dead center and a valve-close timing is before a bottom dead center; ii) a second setting condition in which the valve-open timing of the intake valve is after the top dead center and the valve-close timing is before the bottom dead center; iii) a third setting condition in which the valve-open timing of the intake valve is before the top dead center and the valve-close
- 30       timing is after the bottom dead center; and iv) a fourth setting condition in which the valve-open timing of the intake valve is after the top dead center and the valve-close timing is after the bottom dead center, and the selection-execution step further includes executing a knock control that is selected beforehand for each of the four setting conditions.